CITY OF HERCULES
CITY-WIDE TRAFFIC STUDY

JHK & Associates

March, 1987

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SUMMARY

A city-wide traffic study was initiated by the City of Hercules in the summer of 1986 to assess future transportation needs. The study focuses on a full "Build-Out" peak hour condition which is generally expected to occur by year 2000 or soon thereafter. The study area includes the city's sphere of influence along Franklin Canyon Road.

The existing developments (1986) in the City consist of over 3,300 residential units, about 140,000 square feet of buildings in commercial or light industrial uses, and about 400 acres in heavy industrial uses. Under the "Build-Out" condition, the number of residential units is expected to more than double while the commercial/industrial developments are projected to increase to over 6.5 million square feet. The assumed developments under the "Build-Out" condition were derived from the General Plan by both City staff and the marketing consultant of an on-going Specific Plan study for the Hercules Properties/Gelsar Project area. The assumed land use does not include a BART station in Hercules because no BART station site has been designated in the City's General Plan at this time.

Peak hour trip generations at the present time are estimated to be about 2,100 in the morning and 3,500 in the afternoon. All of the intersections in Hercules are currently operating at a very high level of service with the drivers experiencing negligible delays. However, under the "Build-Out" condition, peak hour trip generations are projected to increase by about 600 percent to 14,800 in the morning and 22,100 in the afternoon. Consequently, severe congestion can be expected at major intersections along both San Pablo Avenue and portions of Sycamore Avenue.

Improvements necessary to accommodate the projected traffic demand and to achieve a "D" or better level of service at all intersections include construction of a new Highway 4 interchange, re-alignment of the eastern section of Sycamore Avenue, widening and installation or modification of signals at 11 intersections, construction of a grade-separation structure at the intersection of San Pablo Avenue and John Muir Parkway, and street widening on sections of San Pablo, Sycamore, and Bayberry Avenues and John Muir Parkway. The locations of these improvements are identified in Figure S-1. Total cost for the improvements is estimated to be about

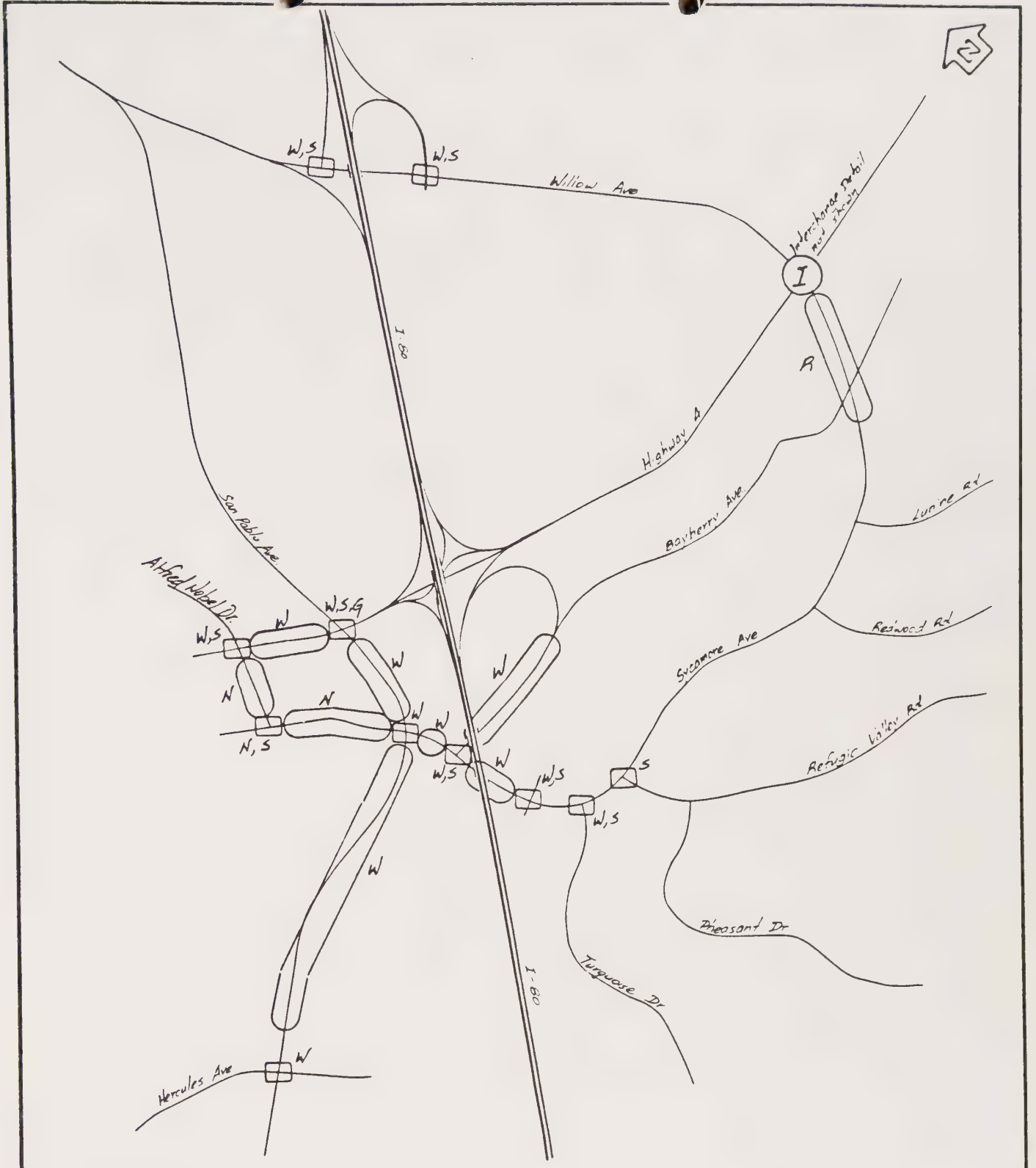

Figure S-1
Required Improvements

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24.5 million dollars. If a BART station is built at the location currently chosen by BART, additional improvements would be necessary.

Potential impacts on level of service and required roadway improvements of improved bus services and other Transportation System Management (TSM) programs were evaluated by assuming a typical 10 percent reduction of work trips attracted to the city and a 4 percent reduction of commute trips made by Hercules residents to the San Francisco/Oakland areas. The results indicate that there will be some reductions in the volume/capacity ratios at critical intersections which would translate into reduced delay. However, the improvements would not be of such magnitude as to effect a change in level of service or require less roadway improvements.

1. INTRODUCTION

The City of Hercules is located about 25 miles north-east of San Francisco in western Contra Costa County. Since 1975, Hercules has been the fastest growing community in the Bay area. In fact, the City's population grew from 252 in 1970 to about 10,500 in 1986. By 1990, the population is expected to increase to over 19,000.

Over the past ten years, the City's growth has been primarily in residential uses. While this residential growth will continue, major industrial and commercial developments are expected to occur in the near future.

A city-wide traffic study was initiated by the City in the summer of 1986 in order to assess future transportation needs and to develop a street improvement program. The study focuses on a full "Build-Out" peak hour condition which is generally expected to occur by year 2000 or soon thereafter. This report documents the methodologies and the findings of the study.

DATA BASE

Data from field surveys and observations were combined with land use and travel characteristics data provided by City and County staff to form the data base for the City-Wide Study. Key elements of this data base are described below:

TRAFFIC COUNTS -- Existing (1986) weekday peak hour traffic volumes at 14 major intersections in the City were obtained from turning movement counts taken in September, 1986. The counts were conducted during both AM and PM peak periods.

TRIP DISTRIBUTION DATA -- A telephone survey of Hercules residents was conducted in September, 1986 to determine directional distributions of work and shopping trips by local residents. In addition, city staff provided, on a city-by-city basis, the residence locations of employees of a major company which is in the process of relocating to the City. Directional distributions of 1980 and year 2000 trips contained in a County-wide model were also compiled from various trip tables previously obtained from Contra Costa County.

LAND USE DATA -- Existing and "Build-Out" land uses were provided by City staff based on the General Plan and the marketing consultant of an on-going specific plan study for the Hercules Properties/Gelsar Project area.

PARK-AND-RIDE -- The number of parking spaces and the current level of utilization at three existing Park-and-Ride lots along Willow and San Pablo Avenues were obtained through field observations.

2. EXISTING CONDITIONS

CIRCULATION SYSTEM

The existing circulation system within and adjacent to the City of Hercules is shown in Figure 2-1. The figure also identifies the types of traffic control at the 14 major intersections which have been the focal points of the analyses in this study.

Interstate 80 (I-80) and State Route 4 (or Highway 4) are regional highways linking the City to other cities in the Bay area. Interstate 80, a 6-lane freeway facility, is a major commute route connecting east and north bay cities to employment centers in the San Francisco and Oakland areas. Highway 4 provides linkage between communities in western and central Contra Costa County. Within the City limit, it is only a two-lane expressway at the present time but, ultimately, will be upgraded to a full freeway.

The interchange at I-80 and Highway 4 is configured in such a way that some of the ramps provide direct highway-to-highway connections, while others provide access to city streets. For most of the existing residential developments in the City and the planned industrial/commercial developments west of I-80, this interchange represents the only access point to Interstate 80.

San Pablo Avenue, which runs in a generally north/south direction west of I-80 is a major arterial roadway with two lanes in each direction plus turn lanes at major intersections. The street runs parallel to I-80 from Oakland to Crockett and is often used as an alternate route when the freeway is congested.

Sycamore and Willow Avenues are two major east/west arterial streets providing linkage between various parts of the City and access to the two regional highways. The streets are basically four-lane roads but have some narrower, two-lane sections. However, the two-lane sections are expected to be widened to four lanes in the future.

Refugio Valley Road is a two-lane divided arterial street providing access to the park lands along Refugio Creek. It will also become the major link between Sycamore Avenue and new developments in Neighborhood 10. All other streets are

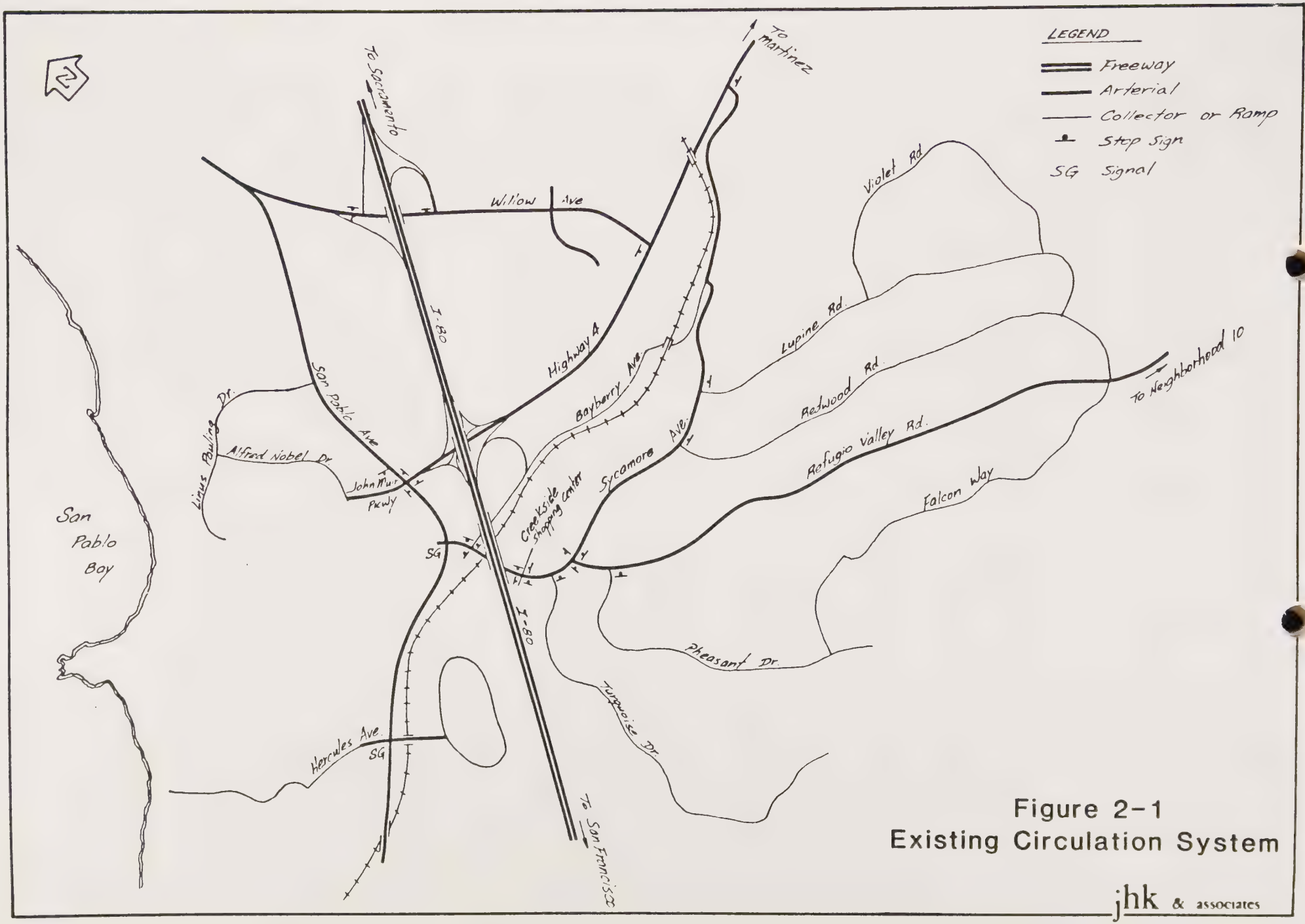

Figure 2-1
Existing Circulation System

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mainly two-lane collector or local access roads serving various neighborhoods in the City.

INTERSECTION OPERATIONS

The ability of a street/highway system to accommodate traffic demand is typically governed by the capacity of its intersections. Intersection capacity analysis is, therefore, a principal tool used in traffic engineering to determine the adequacy of a system in meeting traffic demands.

Since 1965, a level of service concept has been used to express the quality of traffic flow and the degree of congestion a driver can expect at a given intersection. The concept defines the near-capacity condition as Level of Service "E", while a free-flow condition under which a driver would experience very little or no delay is defined as Level of Service "A". A more detailed description of the level of service concept is provided in Table 2-1.

The existing AM and PM peak hour volumes at the 14 major intersections are shown in Figures 2-2 and 2-3, respectively. Of the 14 intersections, only two, at San Pablo/Hercules and San Pablo/Sycamore, are signalized. The remainders are controlled by stop signs either on all approaches or only on minor street approaches . All of the intersections are currently operating at Level of service "A", indicating that the drivers are experiencing negligible delays in the City.

TRANSIT SERVICES

There are currently two bus routes operated by AC Transit in the City of Hercules. Bus stops are located along San Pablo Avenue and at the Park-and-Ride lots on Willow Avenue. Route 70A runs during weekday daytime hours between El Cerrito and Crockett with a headway of one hour. BART Express route "J" runs only during commute hours and provides connection to the Del Norte BART Station in El Cerrito. Also available is the Dial-A-Ride service operated by WESTCAT. This service does not have any fixed routes at the time of this writing and provides transportation on a demand-responsive basis. Its service area includes Pinole, Montara Bay, Rodeo, Crockett, and Port Costa.

Table 2-1

SUMMARY OF LEVELS OF SERVICE FOR INTERSECTIONS

Level of Service	Type of Flow	Volume/Capacity Ratio	Delay	Maneuverability
A	Free flow	0-0.60	Most vehicles arrive during the green phase and do not stop at all. Average delay 0-5.0 seconds.	Turning movements are easily made, and nearly all drivers find freedom of operation.
B	Stable flow	0.61-0.70	Progression is good, although more vehicles stop than for LOS A. Average delays 5.1-15.0 seconds.	Many drivers begin to feel somewhat restricted within groups of vehicles.
C	Stable flow	0.71-0.80	A significant number of vehicles stop. Individual cycle failures may begin to appear at this level. Average delay 15.1-25.0 seconds.	Backups may develop behind turning vehicles. Most drivers feel somewhat restricted, but not objectionably so.
D	Approaching Unstable flow	0.81-0.90	Longer delays result in noticeable congestion. Average delay 25.1-40.0 seconds.	Maneuverability is severely limited during short periods due to temporary backups.
E	Unstable flow	0.91-1.00	Considered the limit of acceptable delay. Individual cycle failures are frequent occurrences. Average delay 40.0-60.0 seconds.	There are typically long queues of vehicle waiting upstream of the intersection.
F	Forced flow	Over 1.00	Excessive delay--unacceptable to most drivers. Average delay greater than 60 seconds.	Jammed conditions. Backups from other locations may restrict or prevent movement of vehicles at the intersection under consideration.

Sources: Highway Capacity Manual, 1965, and Interim Materials on Highway Capacity, 1980, and Highway Capacity Manual, 1985.

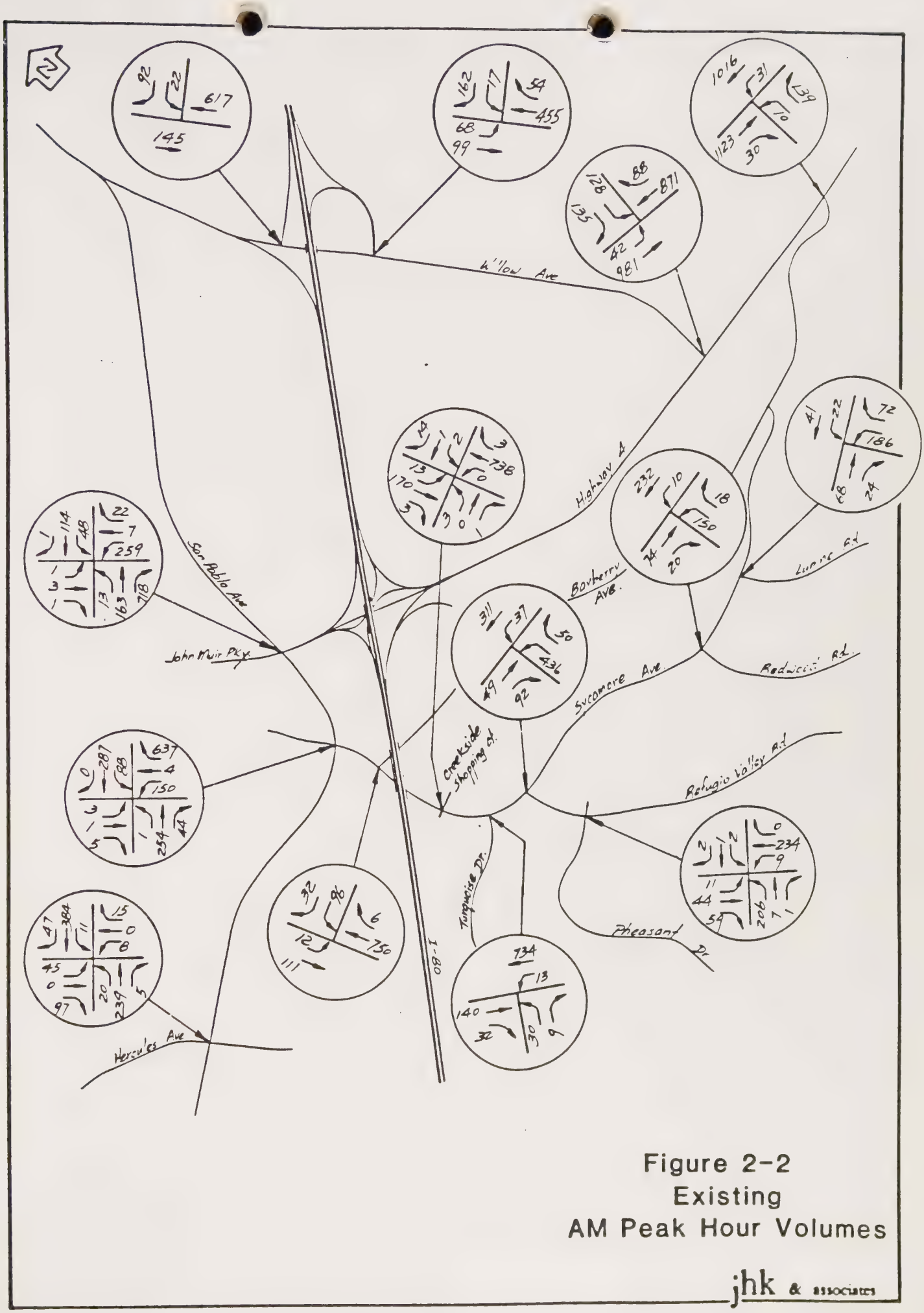

Figure 2-2
Existing
AM Peak Hour Volumes

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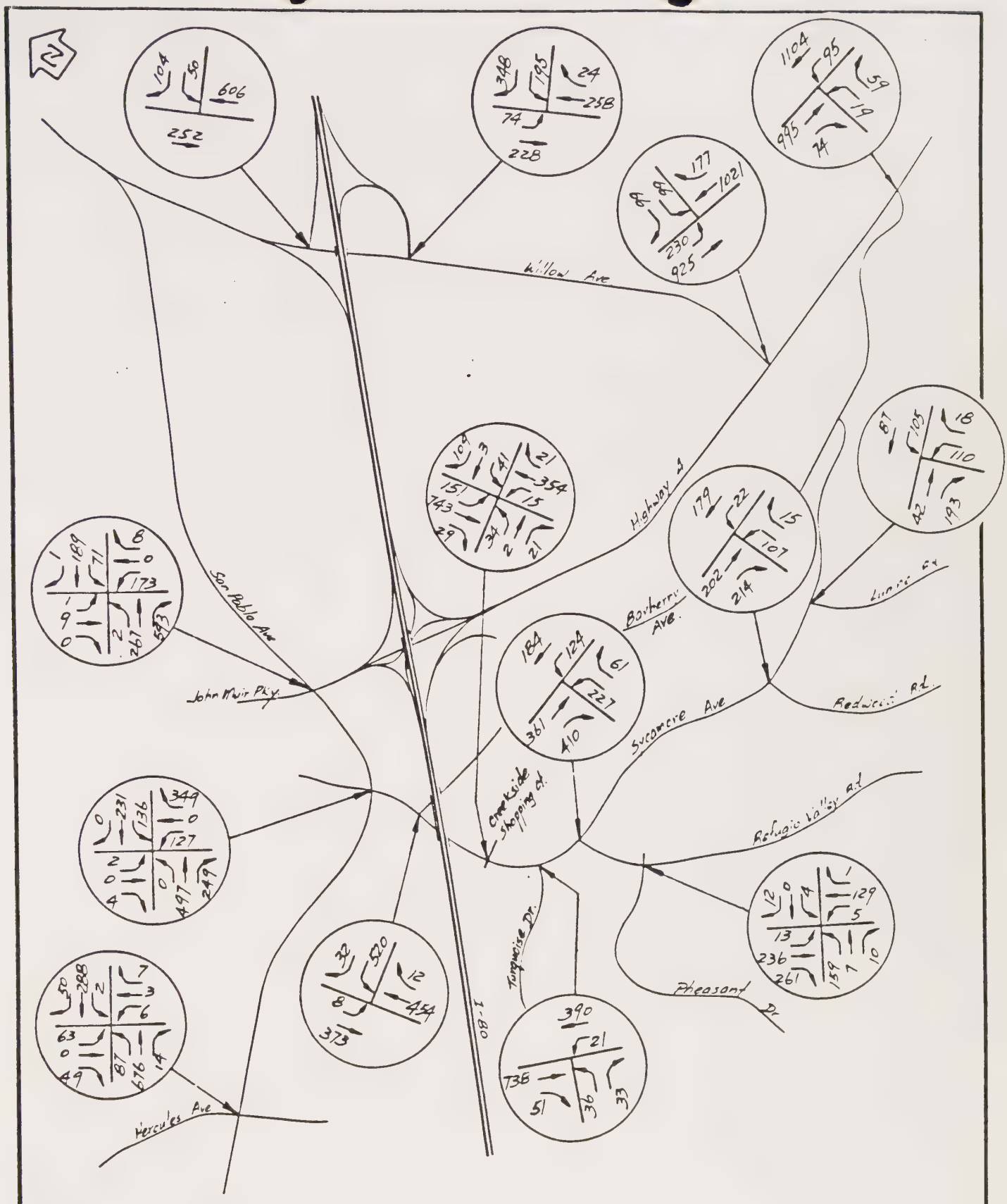

Figure 2-3
Existing
PM Peak Hour Volumes

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Significant changes in both WESTCAT and BART Express bus services are scheduled to take effect July 1, 1987. BART will increase service on the "J" route, adding mid-day and evening buses to the existing service. WESTCAT will convert from a Dial-a-Ride to a local fixed-route system. WESTCAT buses will be coordinated with the BART Express Bus schedule to provide timed transfers and more predictable connections between local and regional transit services.

Within the study area, there are three Park-and-Ride lots adjacent to I-80. Two of the lots are located on Willow Avenue, one on each side of I-80. These two lots combined have a total of over 100 parking spaces. The observed degree of utilization, however, is less than 30 percent. The third lot, with 20 spaces and an observed usage rate of 50 percent, is located on San Pablo Avenue just south of Sycamore.

3. DEMAND PROJECTIONS

Future traffic demands under various land use and network conditions were estimated using a traffic model developed from a package of micro-computer based network analysis programs.

The process involves developing a traffic analysis zone sytem, specifying land uses in each zone, defining roadway networks, determining trip generations and distributions, and assigning trips to the roadway network. An utility subprogram in the program package is also used to perform intersection capacity analyses. The process was first applied to the existing conditions to "calibrate" the model. The calibrated model was then used to project future demands.

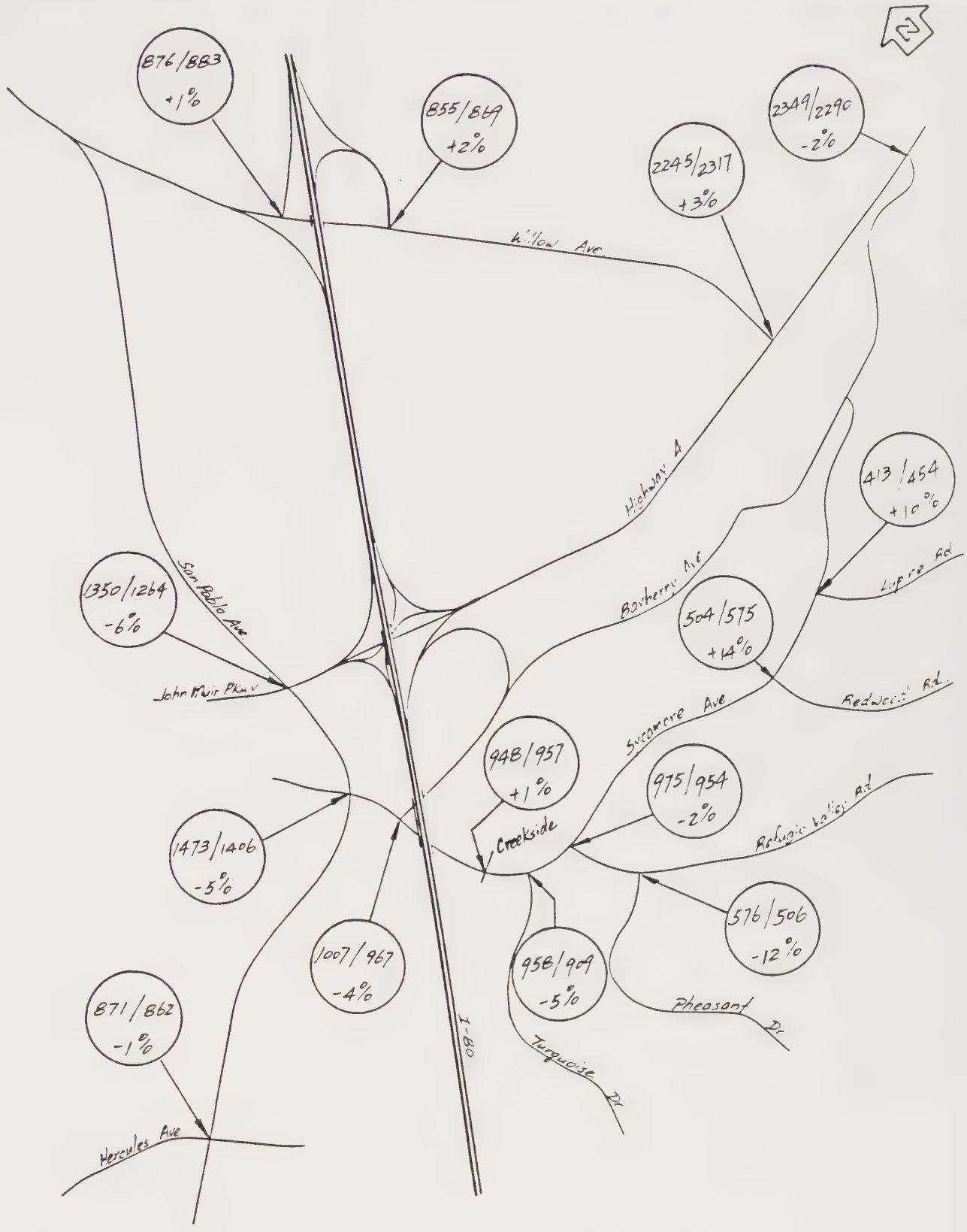
All of the input and output data, and supporting background material have been organized into a technical notebook and submitted to the City for future references. Only summary data and results are provided in this section of the report.

MODEL CALIBRATION

The ability of the traffic model to replicate actual demands on the street system was tested by applying the model to the existing (1986) condition and comparing the model output (predicted values) with actual intersection counts. Through an iterative process, trip generation and distribution parameters, and route assignments were refined (calibrated) until the model provided reasonably accurate prediction of peak hour traffic demands. Figures 3-1 and 3-2 illustrate the calibration results. Some of the deviations are felt to be due to construction activities.

LAND USE ASSUMPTIONS

The assumed land uses under the "Build-Out" condition include over 8,300 residential units, 600 hotel rooms, and over 6.5 million square feet of commercial/industrial developments. These uses were derived by City staff from General Plan designations. A detailed break down by land use group is provided in Table 3-1 (A zone by zone listing of the assumed land uses, together with a zone



LEGEND

Actual Count

xxx / xxx

Model Output

x %

Deviation

Figure 3-1
Model Calibration Results
AM Peak

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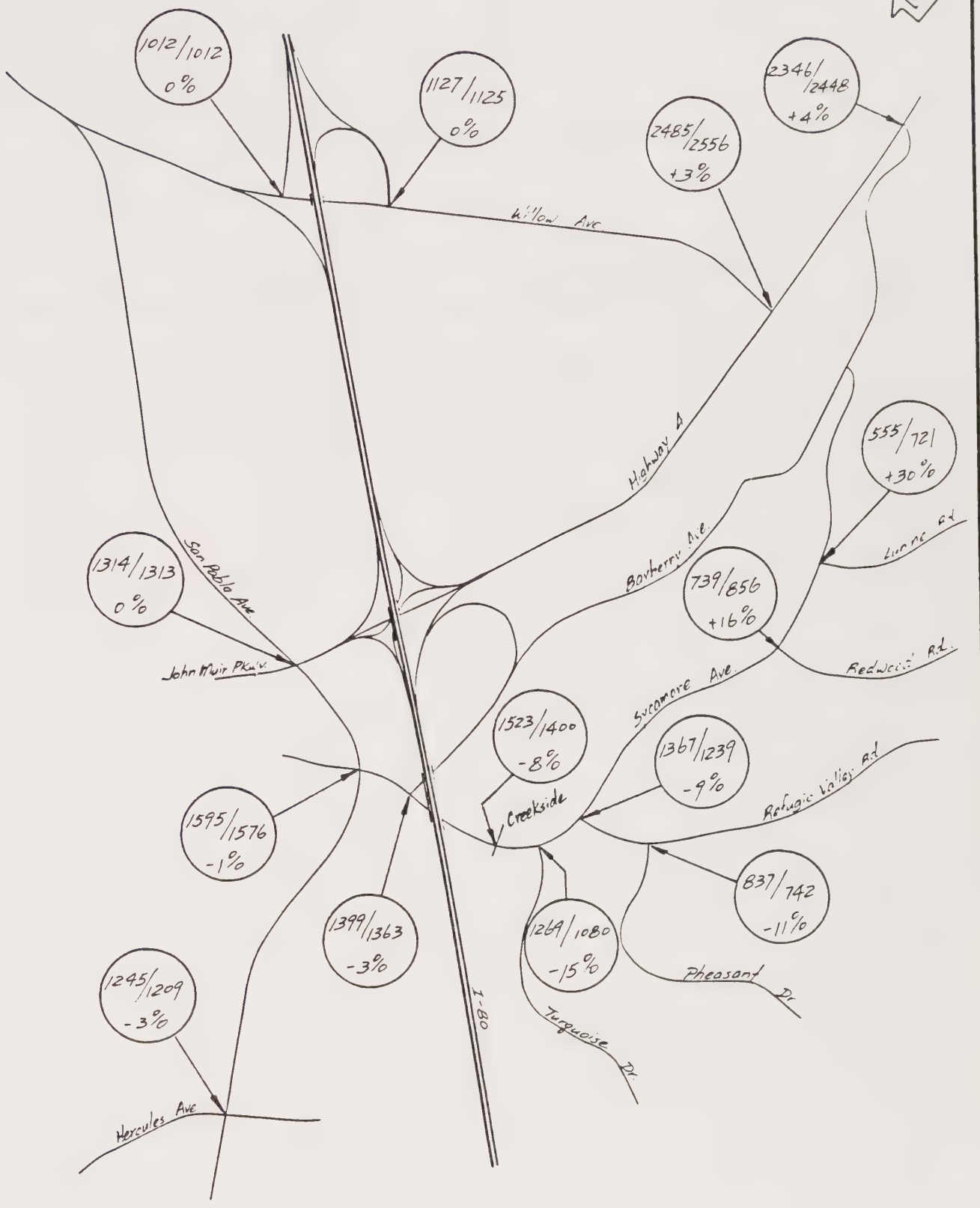

Figure 3-2
Model Calibration Results
PM Peak

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Table 3-1

ASSUMED "BUILD-OUT" LAND USE

Land Use Group	Unit of Measure	Existing (1986)	New Developments			Grand Total at Build-Out
			Sphere of Influence	City Limit	Total	
Residential	Unit	3336	1533	3453	4986	8322
Hotel	Room	0	300	300	600	600
Retail Commercial	1000 S.F.	82	0	838	838	920
Office	1000 S.F.	24	0	1152	1152	1176
Industrial Park	1000 S.F.	0	0	2400	2400	2400
Lt. Industrial	1000 S.F.	30	1054	950	2004	2034
Heavy Industrial	Acre	244	40	0	40	284

map, are provided in Appendix A). For ease of comparison, existing and new developments are tabulated in separate columns. New developments in the sphere of influence are also separately identified in the Table. It can be seen from the table that, in addition to more than doubling the number of residential units, the City is expecting a major growth in the commercial/industrial land use categories in the future.

In addition to the magnitude of development, there is also a spatial distribution aspect of land use that would affect the traffic patterns and the required roadway improvements.

In general, the study area can be divided into five major corridors as shown in Figure 3-3. The San Pablo Avenue corridor, which covers all areas west of I-80, will have the highest concentration of commercial and industrial developments. However, there are also significant residential developments in the southern section of this corridor. The Sycamore Avenue/Refugio Valley Road corridor, which includes areas south of the railroads and east of I-80, is and will continue to be dominated by residential uses. However, there will also be significant community retail developments and public facilities. The largely vacant lands along Bayberry Avenue are to be used exclusively by commercial and industrial developments. The Willow Avenue corridor, which covers the area north of Highway 4 and east of I-80, is mostly built-out with residential developments. Finally, the Highway 4 corridor, which includes mainly the areas in the sphere of influence, will be developed with a mix of residential and industrial uses. The existing Highway 4 will serve as the dividing line between the two uses with residential uses located south of the highway.

Although there have been discussions of a BART extension to Hercules, the timing is unknown and a BART station site has not been designated in the City's General Plan. Consequently, the traffic model has been constructed without a BART station. If a BART station is built in Hercules, there will be BART traffic originating from outside the study area. This BART traffic will therefore need to be added to the demand projected in this study. Currently, BART's preferred station site is located on a parcel of vacant land bounded by I-80, San Pablo Avenue, John Muir Parkway, and Sycamore Avenue. However, a definite station site has not been chosen and BART is considering a study to determine the best location.

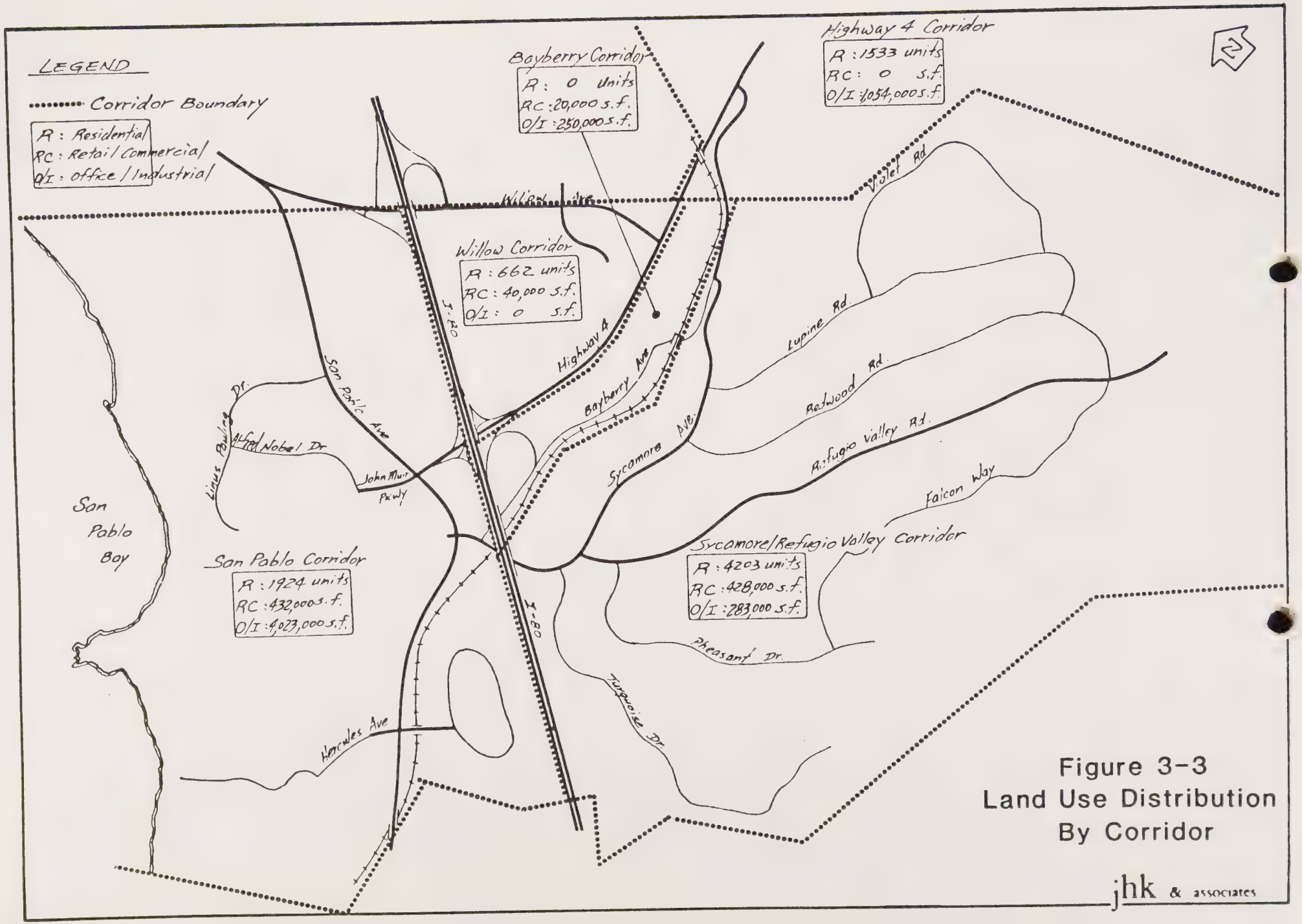

Figure 3-3
Land Use Distribution
By Corridor

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FUTURE NETWORKS

In analyzing future demands and the required improvements, it is necessary to incorporate new roadways and interchanges into the traffic model. Some of the new facilities or network modifications are essentially committed and therefore will certainly become part of the future network while others are still in conceptual stage and require further analyses to establish their needs and feasibility.

New roadways and network modifications which are considered committed include reconstruction of the I-80/Highway 4 interchange, upgrading of Highway 4 to a freeway, realignment of the eastern section of Sycamore Avenue, construction of Sycamore Avenue and John Muir Parkway extensions west of San Pablo Avenue, and construction of a roadway connecting Refugio Vally Road and Franklin Canyon Road through Neighborhoods 10 and 12 (Refugio Valley Ranch and Franklin Canyon Golf Course property).

New facilities which are still in the conceptual stage include a new Highway 4 interchange at or near Willow Avenue, a northbound I-80 on-ramp at Bayberry Avenue and a grade separation structure at the intersection of San Pablo Avenue and John Muir Parkway. The locations of these and the previously mentioned new roadways and network modifications are shown in Figure 3-4.

For the purpose of demand modeling, three alternative networks were constructed reflecting three different assumptions regarding the new Highway 4 interchange.

Alternative 1 -- This alternative assumes that the new Highway 4 interchange will be constructed east of the railroad over-crossing and that the eastern end of Willow Avenue will become an cul-de-sac.

Alternative 2 -- This alternative assumes that the new Highway 4 interchange will be constructed east of the railroad over-crossing but an over-crossing will be constructed to connect Willow Avenue to Bayberry or to a re-aligned section of Sycamore Avenue.

Alternative 3 -- This alternative assumes that there will be a new Highway 4 interchange at Willow Avenue and that Sycamore Avenue will be re-aligned to connect to Willow Avenue at the interchange.

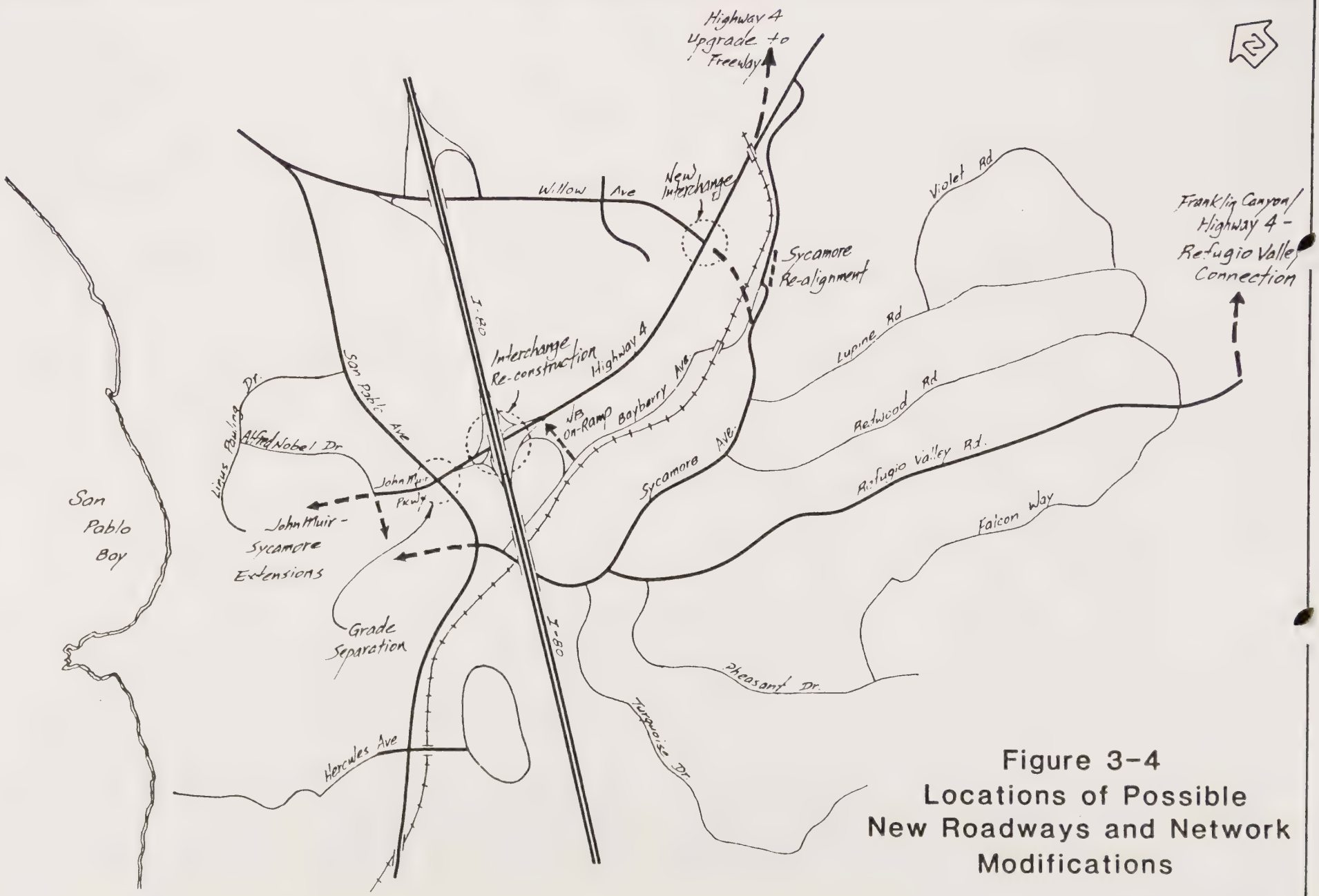

Figure 3-4
Locations of Possible New Roadways and Network Modifications

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The northbound I-80 on-ramp at Bayberry and the grade separation structure at San Pablo/John Muir are not included in the modelled networks; their effects were analyzed manually in performing intersection level of service analyses. The grade separation structure at San Pablo/John Muir is not included in the model because it would not affect the projected demands. The northbound I-80 on-ramp at Bayberry is not modelled because this connection is not considered essential if a new Highway 4 interchange is provided at Willow Avenue.

TRIP GENERATIONS AND DISTRIBUTIONS

The traffic model produces estimates of trips from each traffic analysis zone by multiplying the assumed land use intensities by a set of pre-determined trip rates. These trip rates are generally based on data contained in the "Trip Generation" report published by the Institute of Transportation Engineers. Some of the rates have been refined during the model calibration process. The trip rates as used in the model are shown in Table 3-2.

Under the "Build-Out" condition, a total of 14,800 and 22,100 automobile trips are expected to be generated from the entire city (including sphere of influence) during the AM and PM peak hours, respectively. In comparison, peak hour trip generations at the present time are estimated to be about 2,100 in the morning and 3,500 in the afternoon.

Depending on land use category, trips from each zone were further stratified into eight trip types and distributed to six external zones which represent areas outside the study area boundary (see Table 3-3). A portion of the trips were distributed among the traffic analysis zones within the study area. The proportions of these internal-internal trips are also shown in Table 3-3.

Trips with both origin and destination points outside the study area boundary (external-external trips) were estimated from traffic counts and were projected for future conditions using growth factors developed from population data. This category of trips using San Pablo Avenue, Willow Avenue, and Highway 4 under the "Build-Out" conditions were estimated to be 3,810 and 4,160 during the AM and PM peak hour respectfully. These estimates do not include through trips on I-80 because the model was not intended to produce estimates of traffic demands on I-80.

Table 3-2
TRIP GENERATION RATES

Land Use Type	Unit of Measure	AM Trip Rate	PM Trip Rate
Single Family Residential	Unit	0.52	0.77
Condo/Townhome/Apt	Unit	0.45	0.60
General Office (large user)	1000 S.F.	2.00	2.03
General Office (small user)	1000 S.F.	2.50	2.82
Civic Center	1000 S.F.	2.25	2.85
Industrial Park	1000 S.F.	0.93	0.99
Light Industrial	1000 S.F.	1.11	1.18
Heavy Industrial	Acre	0.40	0.70
Neighborhood Shopping Ct.	1000 S.F.	2.93	14.42
Community Shopping Ct.	1000 S.F.	1.70	6.00
Specialty Retail	1000 S.F.	0.40	4.00
Fastfood Restaurant	1000 S.F.	89.90	31.60
High Quality Restaurant	1000 S.F.	1.02	6.14
Hotel	Room	0.85	0.73
Bank	1000 S.F.	5.40	13.90
Medical Office	1000 S.F.	0.85	3.94
Park and Ride	Space	0.80	0.80
High School	Student	0.27	0.20
Jr./Elementary School	Student	0.15	0.03

Table 3-3

ASSUMED TRIP DISTRIBUTIONS

(A) AM Peak Hour

Trip Type	Percent Internal-Internal	Percent Internal-External	Distribution of Internal-External Trips					
			Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Work-Production	20	80	1	10	70	18	1	0
Shopping Production	95	5	0	20	40	20	20	0
Home-Based Other	20	80	11	13	33	20	22	1
Work Attraction	8	92	24	9	41	8	16	2
Shopping Attraction	30	70	30	8	30	20	8	4
Non-Home-Based Other	10	90	16	11	33	19	21	0
Park-and-Ride Production	100	0	0	0	0	0	0	0
Park-and-Ride Attraction	50	50	60	20	0	2	12	6

(B) PM Peak Hour

Trip Type	Percent Internal-Internal	Percent Internal-External	Distribution of Internal-External Trips					
			Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Work-Production	20	80	1	10	70	18	1	0
Shopping Production	90	10	0	10	50	20	20	0
Home-Based Other	20	80	11	13	33	21	21	1
Work Attraction	7	93	24	9	41	8	16	2
Shopping Attraction	32	68	26	9	31	21	9	4
Non-Home-Based Other	10	90	16	11	33	19	21	0
Park-and-Ride Production	100	0	0	0	0	0	0	0
Park-and-Ride Attraction	50	50	60	20	0	2	12	6

External Zones are:

1. Crockett and areas north
2. Martinez and areas east
3. Pinole Valley and areas south
4. Old Pinole and areas along San Pablo Avenue
5. Rodeo
6. Viewpointe Subdivision

TRAFFIC ASSIGNMENT

Using the trip generation and distribution data, the traffic model produced a set of trip tables which contain the number of trips between each pair of zones. These zone to zone trips were then loaded (or assigned) to the network to produce the projected traffic demands at the intersections.

4. ANALYSES AND RECOMMENDATIONS

The zone to zone trips under the assumed "Build-out" conditions were initially assigned to the existing network. The results indicated that almost all of the major intersections will operate at Level of Service "F" during either or both of the two daily peak hours. It is obvious that there is a need for major roadway improvements.

FUTURE DEMANDS AND RECOMMENDED IMPROVEMENTS

Although the City of Hercules is located at the junction point of two regional highways, access to the highways is severely constrained as a result of several factors:

1. The majority of the trips are oriented toward I-80.

2. There are two I-80 interchanges within the City limit. However, the interchange at Willow Avenue serves only the developments along Willow Avenue which constitutes less than five percent of the total developments (in terms of trip generation) in the City. The overwhelming majority of the City's developments must therefore rely on the interchange at John Muir Parkway/Highway 4 to access I-80.

3. The interchange at I-80/Highway 4/John Muir Parkway must provide both highway-to-highway and highway-to-local street connections. Space limitations dictates that some of the needed connections be omitted, causing circuitous routings and heavy concentration of traffic on San Pablo Avenue.

4. There is very little possibility of constructing another I-80 interchange within the City limit due to difficulties in connecting ramps to city streets.

Analyses of the three network alternatives (see descriptions of the network alternatives on page 3-7) indicated that, unless a new Highway 4 interchange is provided at Willow Avenue, the sections of Sycamore and San Pablo Avenues from Bayberry to John Muir Parkway will be severely congested -- even with extensive widenings and construction of a grade separation structure at San Pablo/John Muir. Therefore, of the three network alternatives, only the third alternative is capable of supporting the traffic demands under the assumed "Build-out" conditions.

The main benefit of providing a new Highway 4 interchange at Willow Avenue is in diverting I-80 oriented trips from San Pablo Avenue and the western section of Sycamore Avenue -- thus leaving the roadway capacity for use by trips generated from developments in the San Pablo Avenue corridor. If the new interchange is located to a point further east, as in the case of Alternatives 1 and 2, the number of diverted trips would be significantly reduced due to an associated increase in travel time and trip length, thereby diminishing the main benefit of the new interchange.

The projected intersection demands for the network with a new Willow/Highway 4 interchange are shown in Figures 4-1 and 4-2 for the AM and PM peak hours, respectively. Volume data for the other two network alternatives is provided in Appendix B.

Given that the new Highway 4 interchange at Willow Avenue is required, the demand and capacity relationships at the key intersections were analyzed to determine the needs for intersection improvements. Improvements necessary to achieve a "D" or better Level of Service during peak hours are illustrated in Figure 4-3 and described below. During off-peak hours, the level of service would be better.

- Install new signals at nine intersections:

  San Pablo/John Muir
  John Muir/Alfred Nobel
  Sycamore/Alfred Nobel
  Sycamore/Bayberry
  Sycamore/Creekside Shopping Center
  Sycamore/Turquoise
  Sycamore/Refugio Valley
  Willow/I-80 southbound off-ramp
  Willow/I-80 northbound ramps

The two intersections at San Pablo/Sycamore and Sycamore/Bayberry are so closely spaced that the signals would need to be coordinated to prevent mutual interference. Although not necessary from capacity point of view, coordination of the entire signal sytem is also recommended because significant benefits in terms of delay reduction and improved air quality can be achieved.

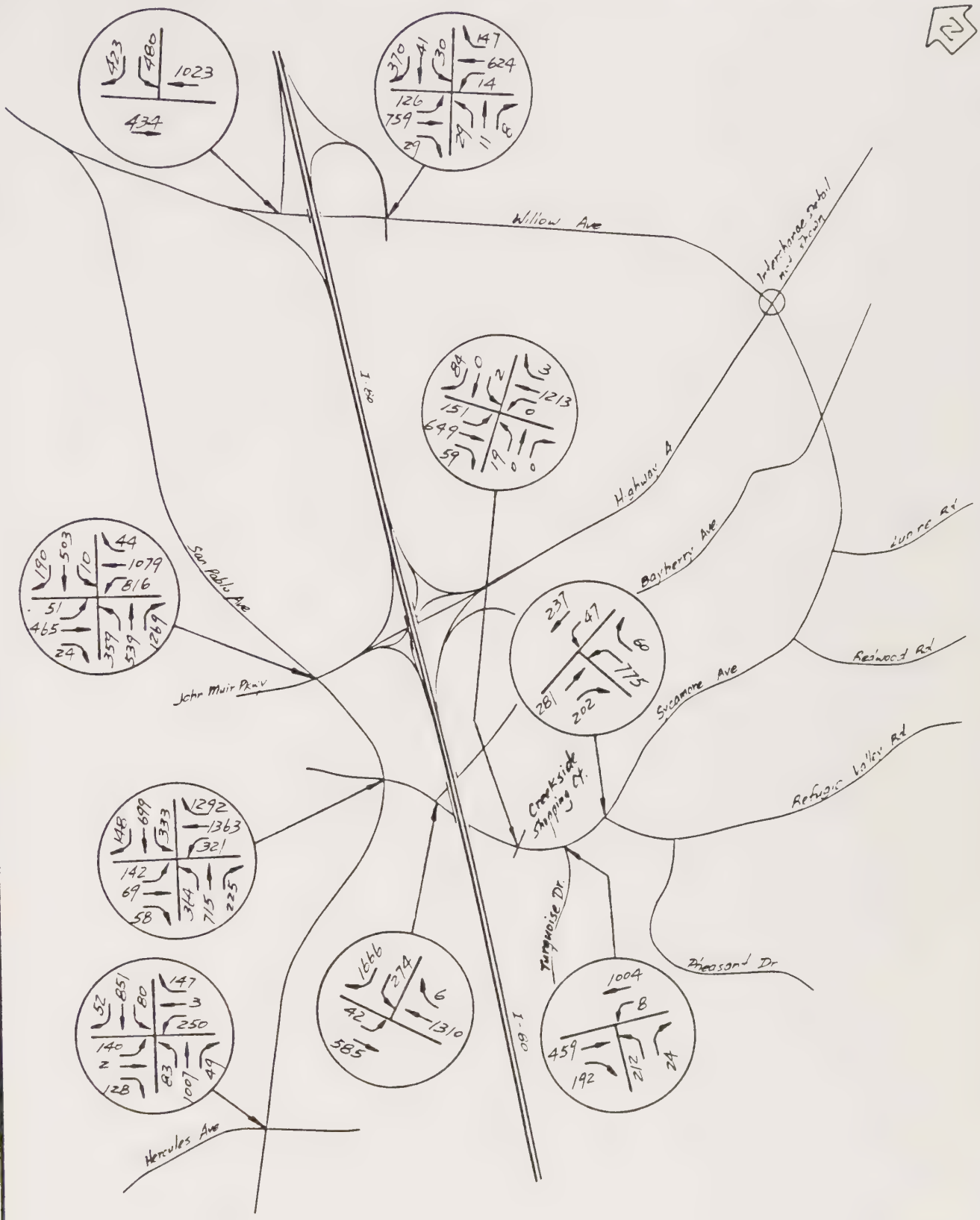

Figure 4-1
Projected Volumes
at Critical Intersections
AM Peak Hour

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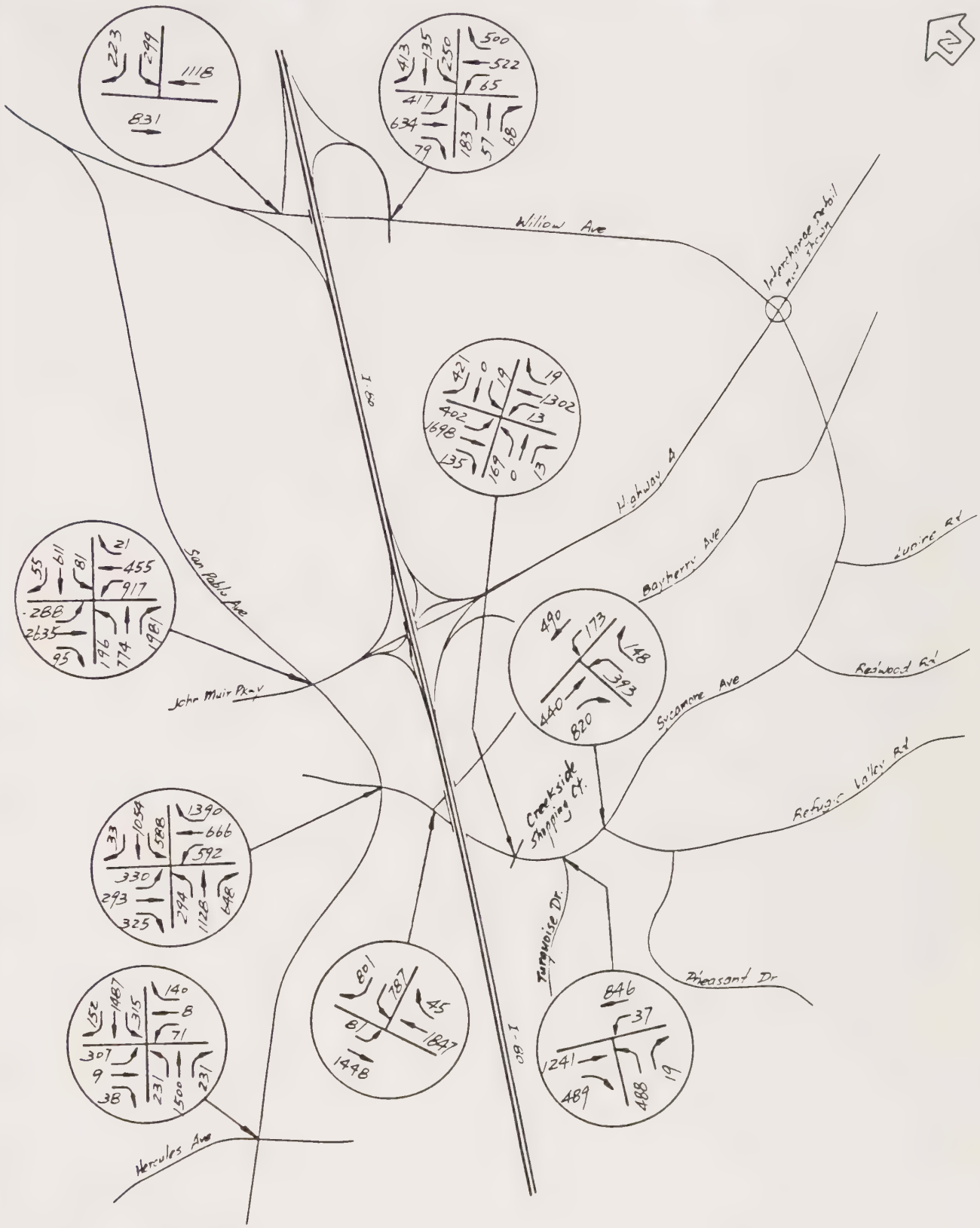

Figure 4-2
Projected Volumes
at Critical Intersections
PM Peak Hour

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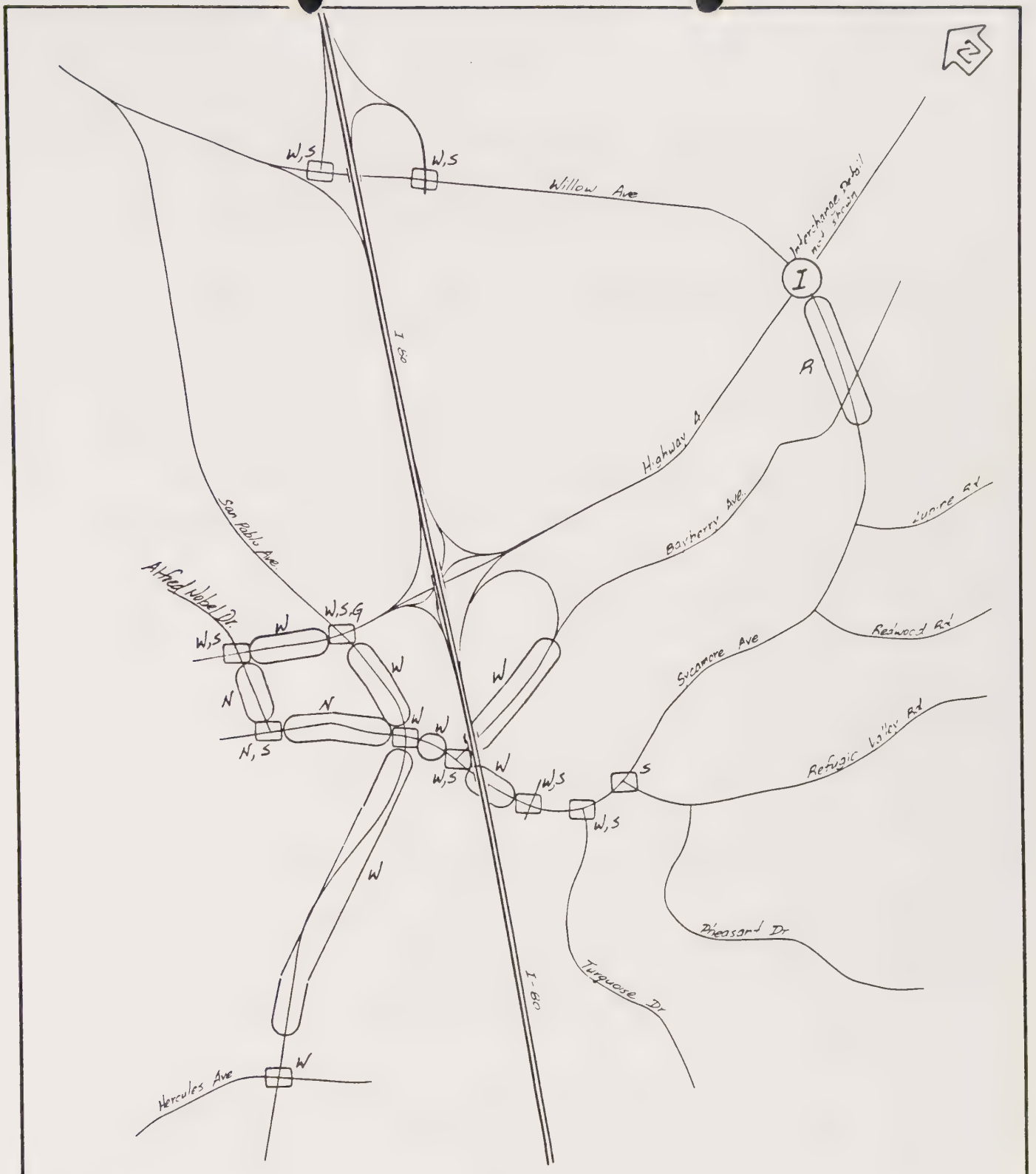

LEGEND

(I) New Interchange

□ Intersection Improvements

▭ Street Improvements

W Widening
S New Signal
G Grade Separation
N New Street
R Re-Alignment

Figure 4-3
Required Improvements

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- o Widen sections of San Pablo, Sycamore, John Muir, Bayberry, Alfred Nobel, and Willow to achieve lane configurations as indicated in Figure 4-4. As a result of the widening, the two existing signals at San Pablo/Sycamore and San Pablo/Hercules would need to be modified.

- o Construct a grade separation structure and a northbound San Pablo to southbound I-80 ramp at San Pablo/John Muir. A concept plan is provided in Figure 4-5.

The effectiveness of the improvements in terms of volume/capacity ratio and level of service is summarized in Table 4-1.

Total cost for the improvements was estimated at 24.5 million dollars. A detailed break-down by items is given in Table 4-2.

Level of Service "D" was chosen for the improvement needs analysis so as to be consistent with the 1983 City-wide Traffic Study. Another reason for using Level of Service "D" was that it is considered acceptable by most Bay Area cities.

An analysis is currently being carried out to determine what additional improvements and/or modifications to the land use would be required if the objective is to achieve a "C" or better level of service during peak hours. The results will be documented in a separate memorandum.

EFFECTS OF TRANSPORTATION SYSTEM MANAGEMENT (TSM)

If transit services are significantly improved (i.e. more routes and shorter headways) and an active TSM program (e.g. car/van pool, flexible work hours) is implemented by major employers or groups of employers in the City, a noticeable reduction in peak hour trips can be realized.

Although a peak hour trip reduction, due to TSM, in the range of 20 to 30 percent has been documented, a 5 to 15 percent reduction is more typical. For this study, the effects of TSM on intersection level of service were analyzed using the assumption that there will be a 10 percent reduction in work trips in zones with significant commercial/industrial developments and a 4 percent reduction in work trips by residents commuting to the south. The analysis results, as summarized in Table 4-3, indicate that there will be some reductions in the volume/capacity ratios

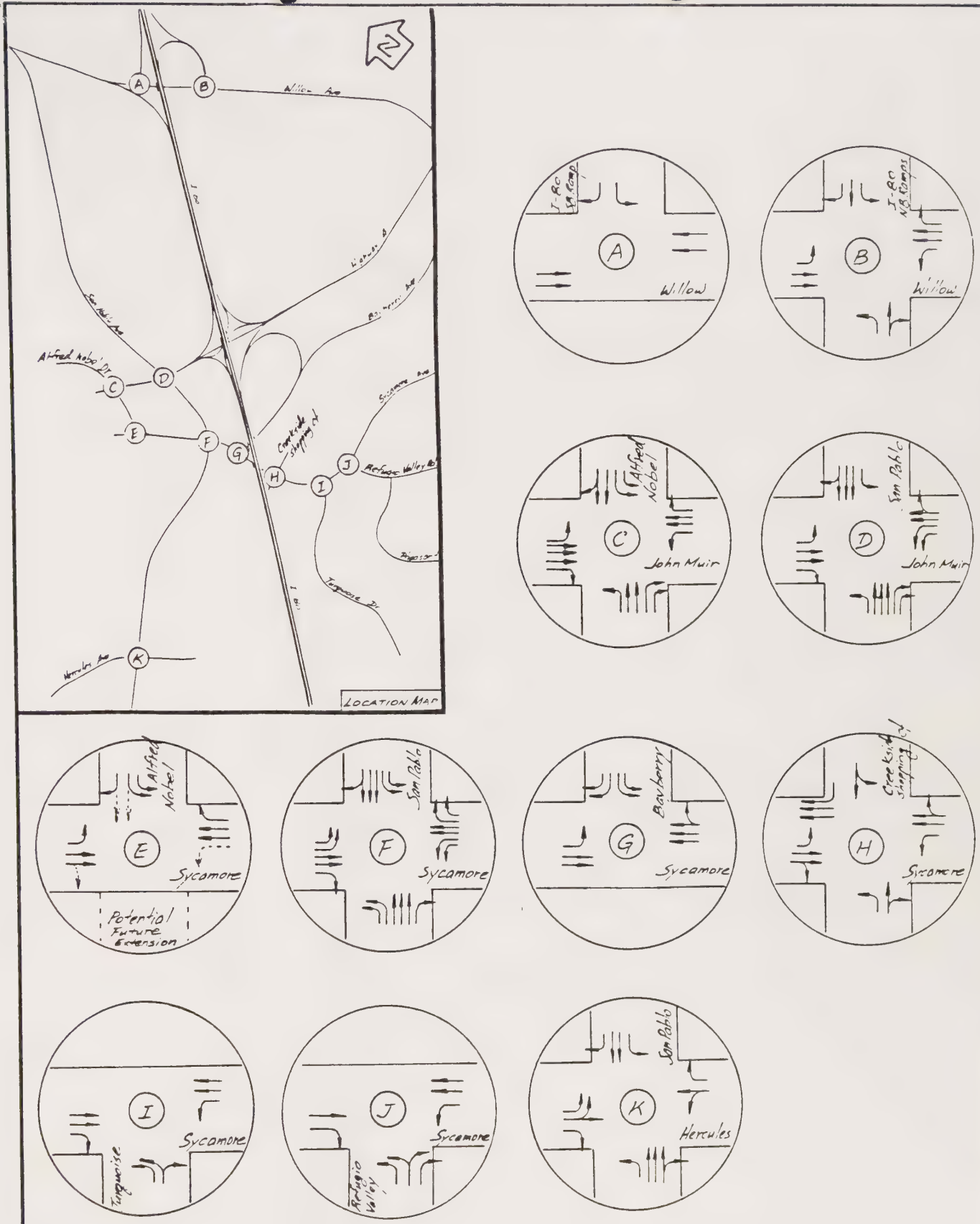

Figure 4-4
Required Lane Configuration at Critical Intersections

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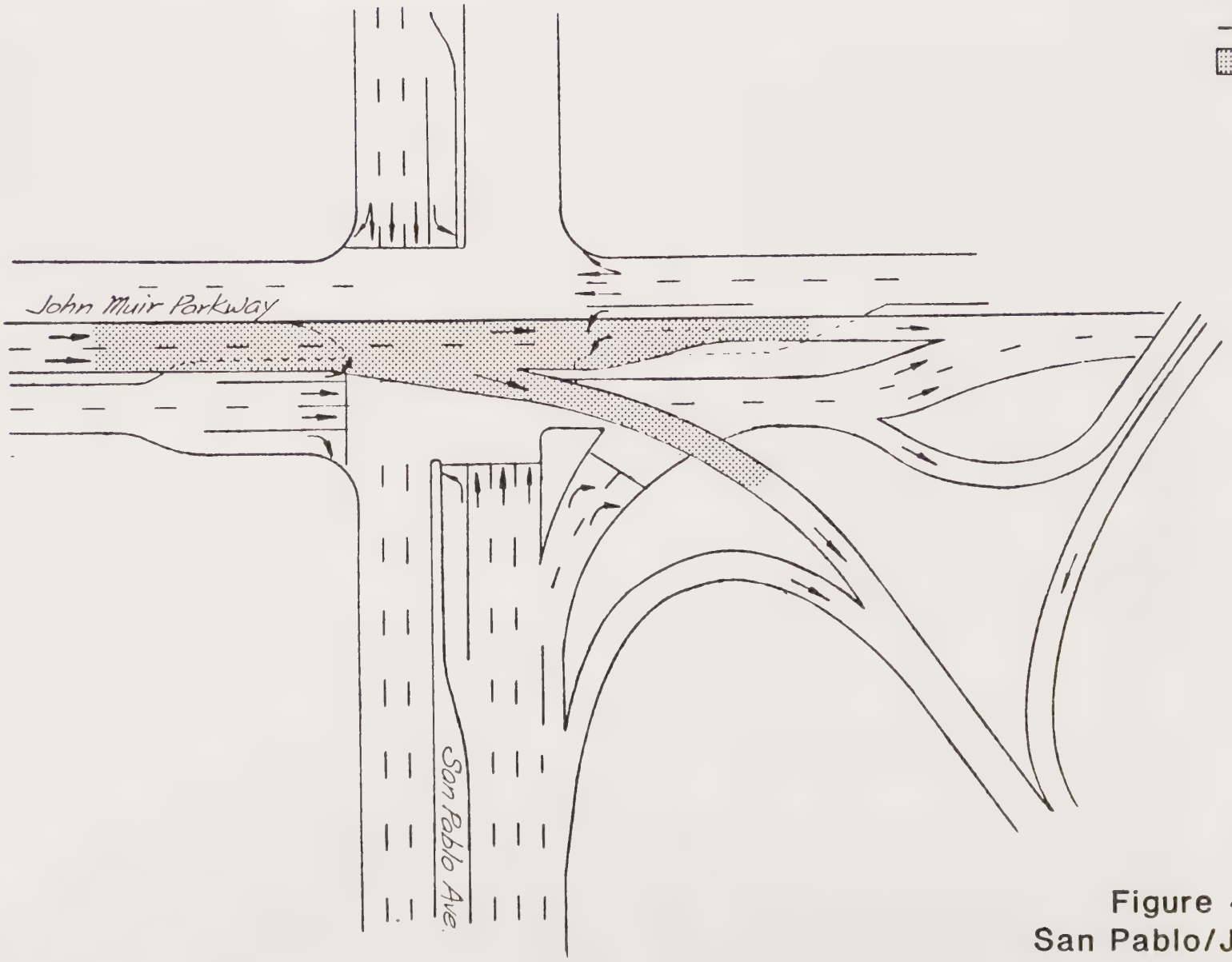

Figure 4-5
San Pablo/John Muir
Grade Separation Concept

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Table 4-1

CAPACITY ANALYSIS SUMMARY - BUILD-OUT CONDITION

Intersection	Without Improvements				With Improvements			
	AM Peak Hr.		PM Peak Hr.		AM Peak Hr.		PM Peak Hr.	
	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
I-80 SB Ramp/Willow	0.84	D	0.92	E	0.69	B	0.64	B
I-80 NB Ramp/Willow	0.70	B	1.01	F	0.52	A	0.77	C
San Pablo/John Muir	1.28	F	2.49	F	0.87	D	0.89	D
San Pablo/Sycamore	1.53	F	1.41	F	0.88	D	0.90	D
San Pablo/Hercules	0.62	B	1.07	F	0.61	B	0.88	D
Bayberry/Sycamore	1.76	F	1.73	F	0.89	D	0.78	C
Creekside/Sycamore	0.60	A	1.16	F	0.55	A	0.88	D
Turquoise/Sycamore	0.48	A	0.93	E	0.44	A	0.64	B
Refugio Valley/Sycamore	0.50	A	0.70	B	0.50	A	0.70	B

Table 4-2

COST ESTIMATES OF IMPROVEMENTS

Item	Unit Cost		Quantity	Cost
1. Hwy 4/Willow Interchange and Sycamore Re-alignment	16,000,000	L.S.	1	$ 16,000,000
2. San Pablo/John Muir Grade Separation	6,000,000	L.S.	1	$ 6,000,000
3. New Signals	120,000	Each	8	$ 960,000
4. Signal Modifications	80,000	Each	2	$ 160,000
5. Signal Coordination	10,000	L.S.	1	$ 10,000
6. Widenings				
A. 1-lane section	120	L.F.	8500	$ 1,020,000
B. 2-lane section	180	L.F.	2000	$ 360,000
			Total	$ 24,510,000

Table 4-3

EFFECTS OF TSM ON LEVEL OF SERVICE

Intersection	Without TSM				With TSM			
	AM Peak Hr.		PM Peak Hr.		AM Peak Hr.		PM Peak Hr.	
	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
I-80 SB Ramp/Willow	0.69	B	0.64	B	0.67	B	0.62	B
I-80 NB Ramp/Willow	0.52	A	0.77	C	0.50	A	0.74	C
San Pablo/John Muir	0.87	D	0.89	D	0.81	D	0.86	D
San Pablo/Sycamore	0.88	D	0.90	D	0.83	D	0.89	D
San Pablo/Hercules	0.61	B	0.88	D	0.60	A	0.86	D
Bayberry/Sycamore	0.89	D	0.78	C	0.84	D	0.77	C
Creekside/Sycamore	0.55	A	0.88	D	0.54	A	0.88	D
Turquoise/Sycamore	0.44	A	0.64	B	0.43	A	0.63	B
Refugio Valley/Sycamore	0.50	A	0.70	B	0.49	A	0.68	B

Assumes all roadway improvements described in this section are built.

which would translate into reduced delay. However, the effects are not of the magnitude that would effect a change in level of service or require less roadway improvements.

Within the Hercules Properties/Gelsar Inc. Specific Plan area, between San Pablo Avenue and Alfred Nobel Drive, a transit transfer station with 200 parking spaces for Park-and-Ride has been assumed, pursuant to the General Plan, in the traffic model. Assuming an 80 percent occupancy rate, this facility could generate 160 peak hour trips. Considering the existing Park-and-Ride usage of less than 40, the assumed level of usage in the future is reasonable. The Park-and-Ride trips constitute less than 1 percent of the total trips generated from the study area and therefore, will not have a significant impact on the circulation system. Consequently, deleting the park-and-ride facility would not eliminate the need for any of the required roadway improvements or allow more developments to occur with the same level of improvements.

ALTERNATIVES

It is necessary to indicate that the required construction of a new Highway 4 interchange at Willow Avenue could encounter a couple of difficulties. One of them is related to Caltrans' policy of maintaining a one-mile spacing between two interchanges. The Willow Avenue interchange can not conform to this policy because it will be located less than one mile from the I-80/Highway 4 interchange. Consequently, a negative response from Caltrans, at least initially, can be expected. Some efforts will be required to convince Caltrans of the need for the interchange. Preliminary analysis has indicated that the interchange can be designed to meet the intent of the policy, i.e. to provide adequate weaving capacity between two interchanges.

The second possible difficulty is in the area of project funding. At present, the availability of State funding for the interchange is very limited. While the situation could change in the future, there is clearly a need to investigate possible local funding, at least partially, for the project.

In the event that the new Highway 4 interchange is not constructed, some of the developments would need to be modified or delayed. Initial analyses on network alternatives have indicated that there is no advantage associated with constructing an over-crossing to connect Willow and Bayberry or Sycamore Avenues if it is not part of the interchange. Consequently, the required reductions or modifications to the assumed developments were analyzed only for Network Alternative 1 (see description on page 3-7).

There are two factors which would influence the required land use changes --1) the level of trip reductions as a result of TSM programs and 2) the availability of a northbound I-80 on-ramp at Bayberry. These two factors in combination define four conditions under which changes in developments would need to be considered if the interchange is not built. The required changes are summarized in Table 4-4 and described below:

1. No TSM program and no Bayberry on-ramp -- Under this condition, the following modifications to the land use would be necessary:

   - Reduction of 490,000 square feet (or 30%) of the office and industrial developments in the Hercules Properties/Gelsar Inc. Specific Plan area located west of I-80 and south of the already approved Bio-Rad/North Shore Business Park developments.

   - Substitute 340,000 square feet of office and retail commercial developments east of I-80 with 250 units of residential developments. This change would impact all or part of the 25-acre site east of the new City Hall and possibly other developments.

   - Substitute 250,000 square feet of industrial developments along Bayberry Avenue with uses such as mini-warehouse or churches which generate very few peak hour trips.

2. No TSM program but with the Bayberry I-80 on-ramp --Under this condition, the first two items of change as described above would be required. However, the industrial developments along Bayberry can be allowed to proceed.

3. With TSM but without the Bayberry on-ramp -- Under this condition, a reduction of 164,000 square feet (10%) in office and industrial developments in the Hercules Properties/Gelsar Inc.

Table 4-4

REQUIRED LAND USE MODIFICATIONS WITHOUT HIGHWAY 4/WILLOW INTERCHANGE

Condition	Reduce 490,000 s.f. of Office/Industrial Developments West of I-80	Reduce 164,000 s.f. of Office/Industrial Developments West of I-80	Substitute 340,000 s.f. of Office/Retail Developments East of I-80	Substitute 250,000 s.f. of Industrial Developments along Bayberry with low trip generator
No TSM No Bayberry On-Ramp	√		√	√
No TSM With Bayberry On-Ramp	√		√	
With TSM No Bayberry On-Ramp		√	√	√
With TSM With Bayberry On-Ramp		√	√	

Specific Plan area and the last two items of change, as described under Scenario 1, would be required.

4. With TSM and with the Bayberry I-80 on-ramp -- Under this condition, the industrial development along Bayberry can be allowed to proceed but other changes, described under Scenario 3, would be required. Thus, the modifications to land use would include reduction of 164,000 square feet in office and industrial developments west of I-80 and the substitution of 340,000 square feet of office and retail commercial developments east of I-80 with 250 units of residential developments.

Use of Level of Service "C" as an alternative criterion for determining improvement needs or required land use modifications is currently under study. The results will be documented in a separate memorandum.

APPENDIX A

Traffic Analysis Zone System
Land Use Listing by Zone

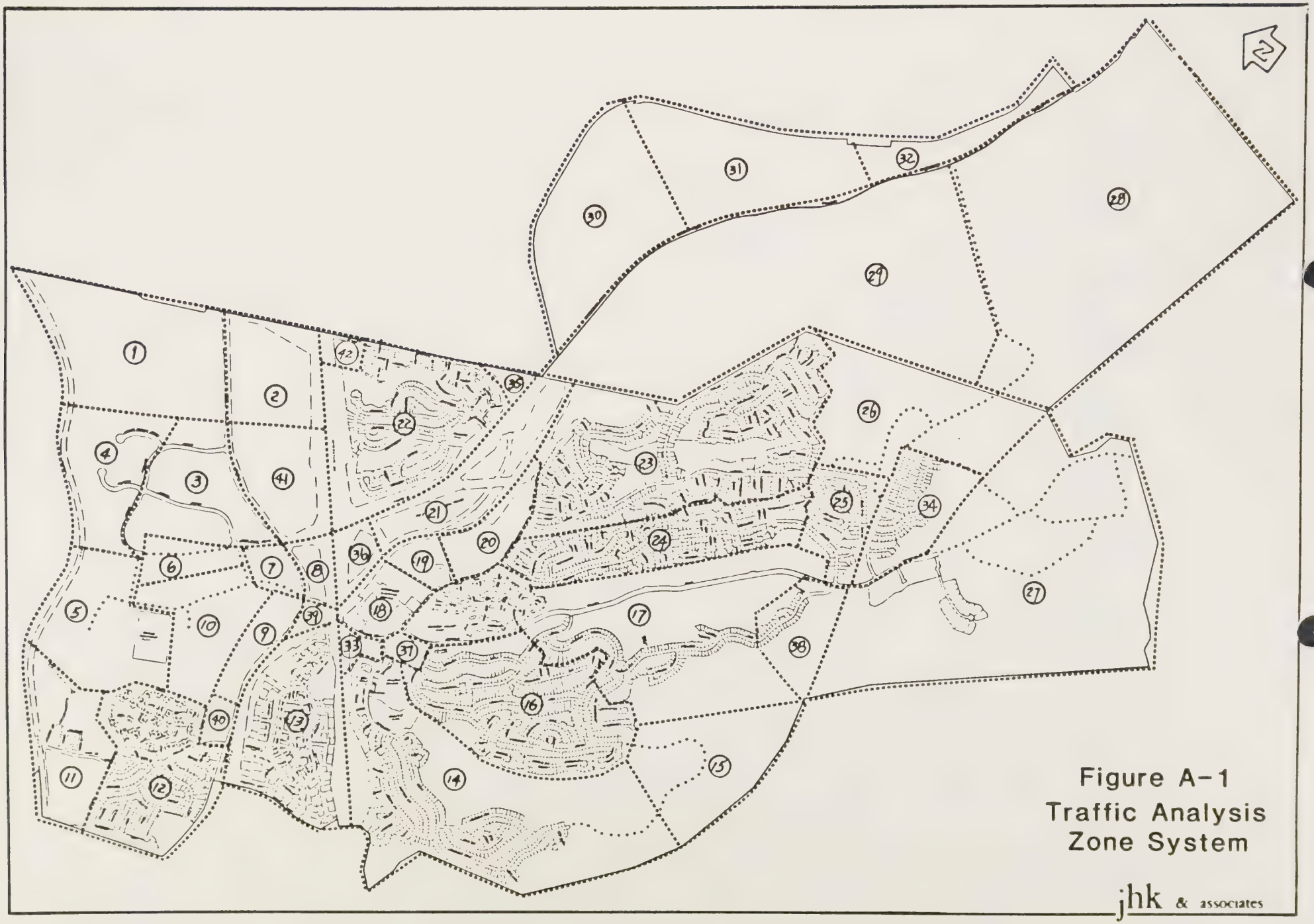

Figure A-1
Traffic Analysis
Zone System

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HERCULES LAND USE -- BUILD-OUT CONDITION

LAND USE TYPE UNIT OF MEASURE	SINGLE FAMILY HOUSE UNITS	APT./ CODO. UNITS	LARGE USER OFFICE 1000 SF	SMALL USER OFFICE 1000 SF	CIVIC CENTER 1000 SF	INDUST. PARK 1000 SF	LIGHT INDUST. 1000 SF	HEAVY INDUST. ACRE	NEIBOR. SHOPP'G CENTER 1000 SF	COMMUN. SHOPP'G CENTER 1000 SF	SPEC'L RETAIL 1000 SF
ZONE NUMBER	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE
1								144			
2						650					
3				300		500				200	
4						900					
5			350	5		350	76				40
6							338				
7				208						100	
8									10		
9											
10							316				
11	20	206									
12	245	301									
13		1152									
14	405	64									
15	138										
16	546										
17	405	264									
18				4						138	36
19					40						
20				170						170	
21							250				
22	273	305									
23	677										
24	480										
25	87										
26	150										
27	336	507									
28	450	700									
29	383										
30							1000				
31								140			
32							54				
33				15					18		
34	102										
35		84									
36									20		
37				40					60		
38	42										
39									20		
40				30					40		
41											
42									40		
43											
44											
45											
TOTAL SIZE:	4739	3583	350	772	40	2400	2034	284	208	608	76

LAND USE TYPE :

UNIT OF MEASURE :	FASTFOOD RESTAUR. 1000 SF	HIGH QUAL. RESTAUR. 1000 SF	HOTEL ROOM	BANK 1000 SF	MEDICAL OFFICE 1000 SF	HIGH SCHOOL STUDENT	JR./ELEM. SCHOOL STUDENT	PARK & RIDE SPACES	PARK/ REC. ACRE	TRUCK TERMINAL ACRE	SERVICE STATION EACH	GOLF COURSE ACRE
ZONE NUMBER	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE
1												
2												
3												
4												
5		10							26			
6												
7			200					200				
8	4	8	100								1	
9						1200						
10												
11							400					
12												
13												
14												
15												
16							450					
17												
18				6	4							
19												
20												
21												
22												
23							450					
24												
25												
26												
27												
28			300									150
29												
30												
31												
32										5		
33					10							
34												
35												
36												
37												
38												
39												
40												
41												
42											1	
43												
44												
45												
TOTAL SIZE:	4	18	600	6	14	1200	1300	200	26	5	2	150

APPENDIX B

- Projected AM Peak Hour Volumes - Network Alternative 1
- Projected PM Peak Hour Volumes - Network Alternative 1
- Projected AM Peak Hour Volumes - Network Alternative 2
- Projected PM Peak Hour Volumes - Network Alternative 2

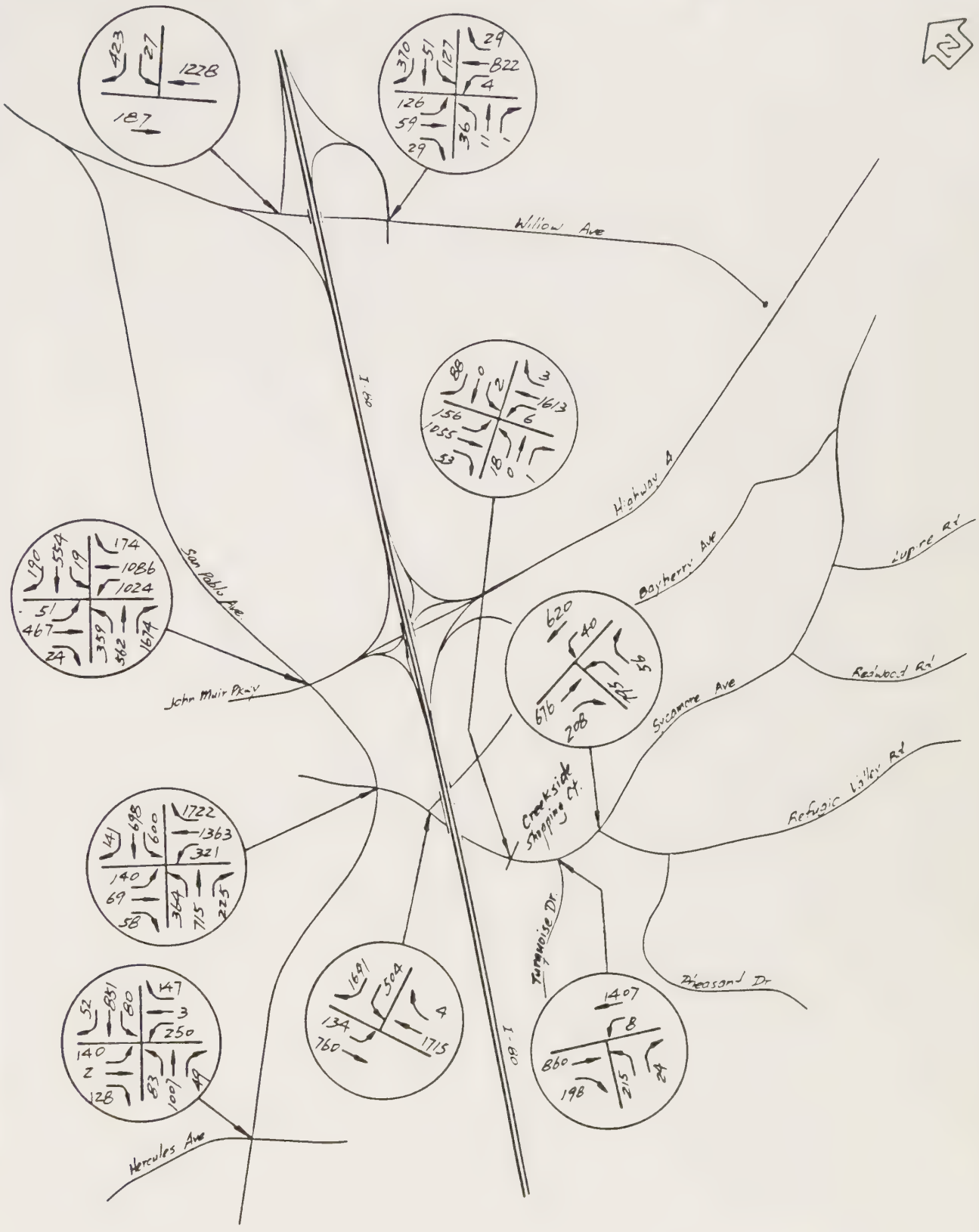

Figure B-1
Projected AM Peak Hour Volumes
Network Alternative 1

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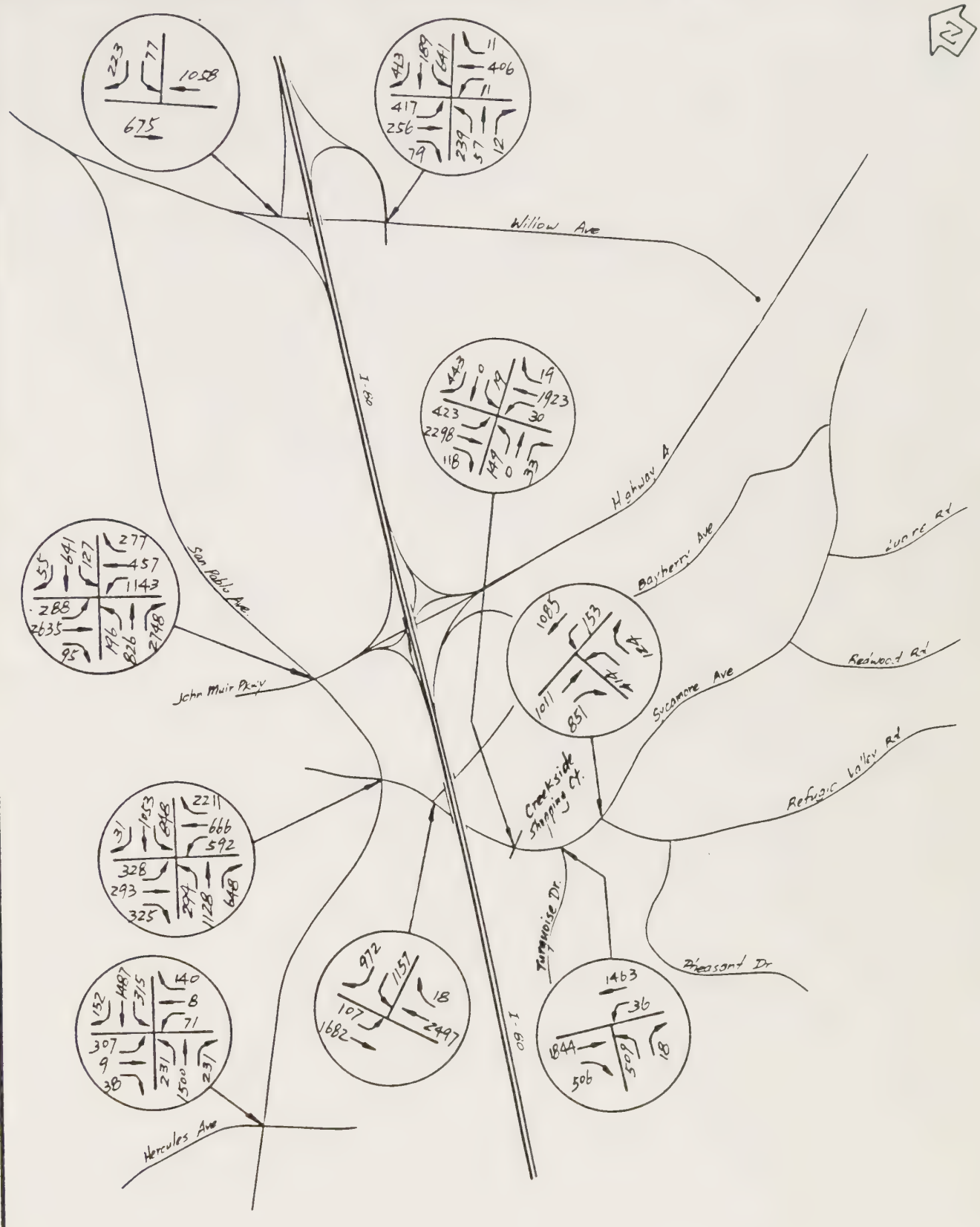

Figure B-2
Projected PM Peak Hour Volumes
Network Alternative 1

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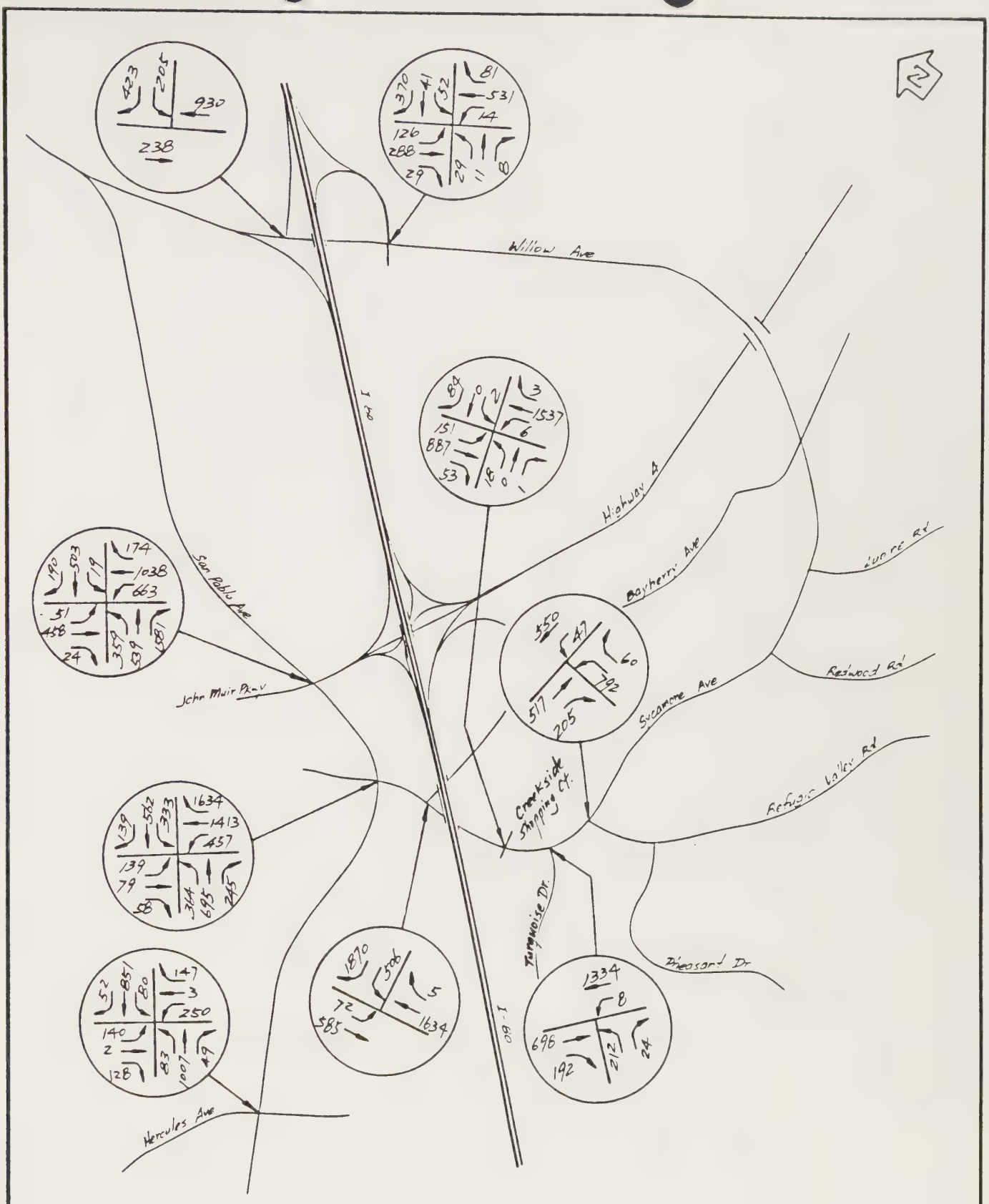

Figure B-3
Projected AM Peak Hour Volumes
Network Alternative 2

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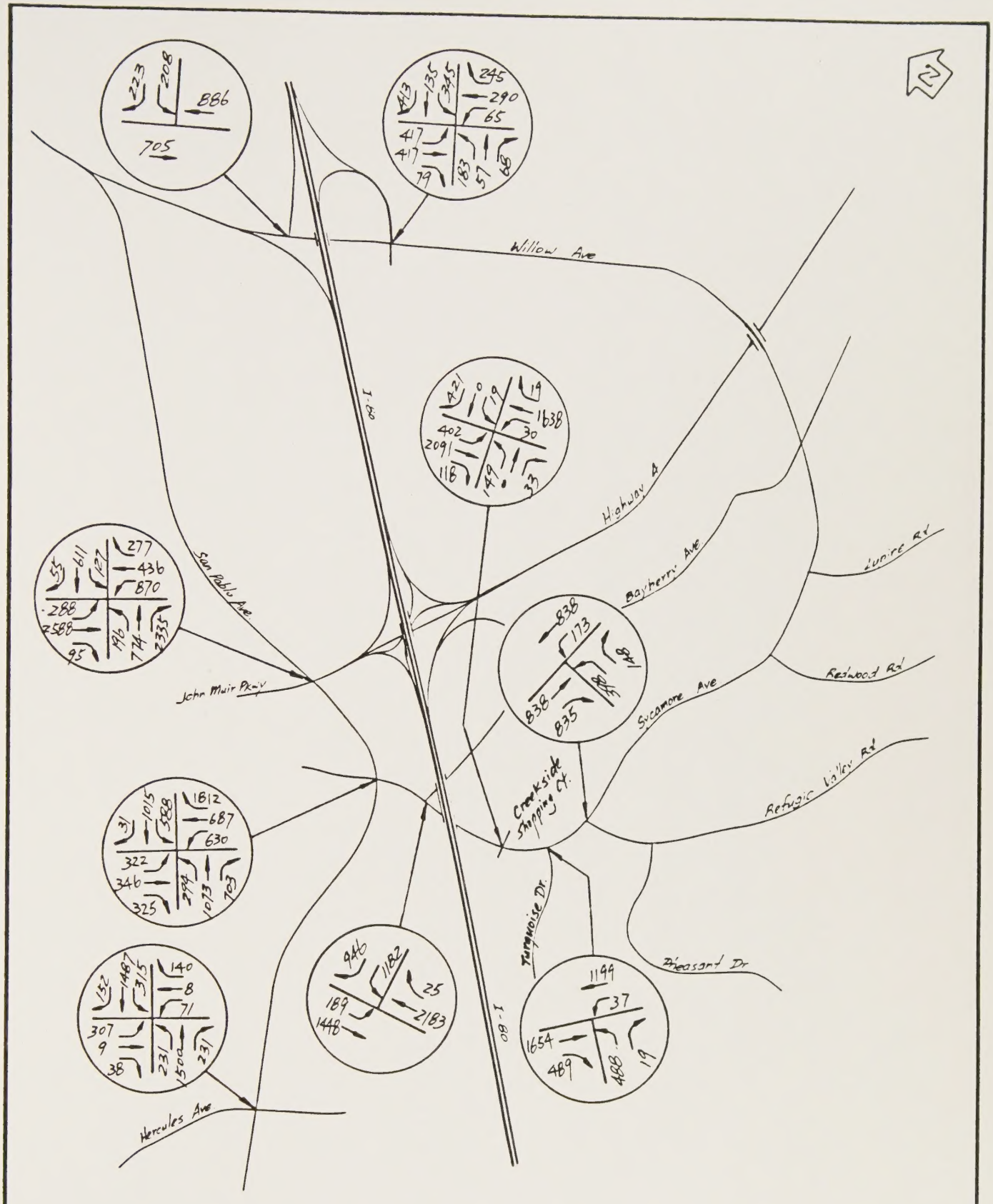

Figure B-4
Projected PM Peak Hour Volumes
Network Alternative 2

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